

US EPA ARCHIVE DOCUMENT

LON C HILL REDEVELOPMENT PROJECT
LON C. HILL, LP

Proposed BACT Limit Summary Table (2x2x1 Configuration, Net Basis)

System	Heat Rate Net Basis (Btu/kWh) (HHV)	Output-Based CO₂ Emission Rate Net Basis (lb_{CO2}/MWh)^{(1),(2)}	MSS CO₂ Emission Rate (ton_{CO2}/hr)⁽²⁾
Siemens SCC6-5000F, or GE S207FA.04, or equivalent	7,720	920	115

Notes

(1) This limit applies with and without duct burner firing during normal operations

(2) Limits are based on a 12-month rolling average.

BACT Limits Summary Table (2x2x1 Configuration, Net Basis)

System	Heat Rate Net Basis (Btu/kWh) (HHV)	Output-Based CO₂ Emission Rate Net Basis (lb_{CO2}/MWh)^{(1),(2)}	MSS CO₂ Emission Rate (ton_{CO2}/hr)⁽²⁾
Siemens SCC6-5000F	7,693	914	113
GE S207FA.04 (with cooling tower)	7,670	911	111
GE S207FA.04 (with air condenser)	7,719	917	112

Notes

(1) This limit applies with and without duct burner firing during normal operations

(2) Limits are based on a 12-month rolling average.

LON C HILL REDEVELOPMENT PROJECT
LON C. HILL, LP

Siemens SCC6-5000F Output-Based CO₂ Emission Rate (Full Load)

Parameter	Units	Unfired	Fired	Proposed
Heat Rate, Net Basis ⁽¹⁾	Btu/kWh (LHV)	6,120	6,225	
Heat Rate, Net Basis ⁽²⁾	Btu/kWh (HHV)	6,788	6,905	
Compliance Margin ⁽³⁾	-	12.3%	12.3%	
Annual Hours of Operation ⁽⁴⁾	hr/yr	3,785	4,375	8,160
Adjusted Heat Rate, Net Basis ^{(5),(6)}	Btu/kWh (HHV)	7,623	7,754	7,693
CO ₂ Emission Factor ⁽⁷⁾	lb _{CO2} /MMBtu	118.8	118.8	118.8
Output-Based CO ₂ Emission Rate, Net Basis ⁽⁸⁾	lb _{CO2} /MWh	906	921	914

Notes

(1) As provided by vendor performance data.

(2) Heat Rate Net Basis (Btu/kWh) (HHV) = Heat Rate Net Basis (Btu/kWh) (LHV) * Ratio HHV/LHV

HHV/LHV Ratio = 1.1 based on fuel heating value (Btu/lbm) per vendor data

(3) Compliance margin (12.3%) accounts for the variance of the design heat rate and the achieved heat rate, losses due to equipment degradation and variability on auxiliary plant equipment.

Design margin 3.3% reflects possible variation in design vs actual heat rate given actual operating and ambient conditions.

Performance margin 6.0% reflects efficiency losses due to equipment degradation prior to maintenance overhauls.

Degradation margin 3.0% reflects the variability in operation of auxiliary plant equipment due to use over time.

(4) Estimated annual hours of operation represent one expected operating scenario and are not intended to limit the permitted operations of Lon C. Hill Power Station. Lon C. Hill Power Station will meet the proposed output-based CO₂ emission rate on a 12-month rolling average and gross basis, regardless of the actual hours of run time in each of the operational modes:

Unfired = 3,785 hr

Fired = 4,375 hr

MSS = 600 hr

(5) Adjusted Heat Rate Net Basis (Btu/kWh) (HHV) = Heat Rate Net Basis (Btu/kWh) (HHV) * (1 + Compliance Margin)

Adjusted Heat Rate Net Basis (Unfired) = 6,788 Btu/kWh (HHV) * (1 + 0.123) = 7,623 Btu/kWh (HHV)

(6) Proposed Heat Rate (Btu/kWh) = [HR (Btu/kWh) * Annual Op (hr/yr)_{Unfired} + HR (Btu/kWh) * Annual Op (hr/yr)_{Fired}] / [Annual Op (hr/yr)_{Unfired} + Annual Op (hr/yr)_{Fired}]

Proposed Heat Rate = [7,623 Btu/kWh * 3,785 hr/yr + 7,754 Btu/kWh * 4,375 hr/yr] / 8,160 hr/yr = 7,693 Btu/kWh

(7) CO₂ emission factor calculated per 40 CFR Part 75, Appendix G, Equation G-4, as referenced in §98.43(a), where:

CO₂ Emission Factor = 1,040 scf/MMBtu / 385scf/lbmole * 44lb/lbmole = 118.8 lb/MMBtu

Carbon based F-factor, F_C = 1,040 scf/MMBtu

Standard Molar Volume = 385 scf/lbmole

Molecular Weight CO₂, MW_{CO2} = 44 lb/lbmole

(8) CO₂ Emission Rate Net Basis (lb_{CO2}/MWh) = Heat Rate Net Basis (Btu/kWh) * 1MMBtu/1,000,000 Btu * CO₂ Emission Factor (lb_{CO2}/MMBtu) * 1,000 kW/MW

CO₂ Output-Based Emission Rate (Unfired), Net Basis = 7,623 Btu/kWh * 1 MMBtu/1,000,000 Btu * 118.8 lbCO₂/MMBtu * 1,000 kW/MW = 906 lbCO₂/MWh

CO₂ Output-Based Emission Rate (Fired), Net Basis = 7,754 Btu/kWh * 1 MMBtu/1,000,000 Btu * 118.8 lbCO₂/MMBtu * 1,000 kW/MW = 921 lbCO₂/MWh

CO₂ Output-Based Emission Rate (Proposed), Net Basis = 7,693 Btu/kWh * 1 MMBtu/1,000,000 Btu * 118.8 lbCO₂/MMBtu * 1,000 kW/MW = 914 lbCO₂/MWh

LON C HILL REDEVELOPMENT PROJECT
LON C. HILL, LP

GE S207FA.04 with Cooling Tower Output-Based CO₂ Emission Rate (Full Load)

Parameter	Units	Unfired	Fired	Proposed
Heat Rate, Net Basis ⁽¹⁾	Btu/kWh (LHV)	6,041	6,266	
Heat Rate, Net Basis ⁽²⁾	Btu/kWh (HHV)	6,696	6,946	
Compliance Margin ⁽³⁾	-	12.3%	12.3%	
Annual Hours of Operation ⁽⁴⁾	hr/yr	3,785	4,375	8,160
Adjusted Heat Rate, Net Basis ^{(5),(6)}	Btu/kWh (HHV)	7,520	7,800	7,670
CO ₂ Emission Factor ⁽⁷⁾	lb _{CO2} /MMBtu	118.8	118.8	118.8
Output-Based CO ₂ Emission Rate, Net Basis ⁽⁸⁾	lb _{CO2} /MWh	893	927	911

Notes

(1) As provided by vendor performance data.

(2) Heat Rate Net Basis (Btu/kWh) (HHV) = Heat Rate Net Basis (Btu/kWh) (LHV) * Ratio HHV/LHV

HHV/LHV Ratio = 1.1 based on fuel heating value (Btu/lbm) per vendor data

(3) Compliance margin (12.3%) accounts for the variance of the design heat rate and the achieved heat rate, losses due to equipment degradation and variability on auxiliary plant equipment.

Design margin = 3.3% reflects possible variation in design vs actual heat rate given actual operating and ambient conditions.

Performance margin = 6.0% reflects efficiency losses due to equipment degradation prior to maintenance overhauls.

Degradation margin = 3.0% reflects the variability in operation of auxiliary plant equipment due to use over time.

(4) Estimated annual hours of operation represent one expected operating scenario and are not intended to limit the permitted operations of Lon C. Hill Power Station. Lon C. Hill Power Station will meet the proposed output-based CO₂ emission rate on a 12-month rolling average and gross basis, regardless of the actual hours of run time in each of the operational modes:

Unfired = 3,785 hr

Fired = 4,375 hr

MSS = 600 hr

(5) Adjusted Heat Rate Net Basis (Btu/kWh) (HHV) = Heat Rate Net Basis (Btu/kWh) (HHV) * (1 + Compliance Margin)

Adjusted Heat Rate Net Basis (Unfired) = 6,696 Btu/kWh (HHV) * (1 + 0.123) = 7,520 Btu/kWh (HHV)

(6) Proposed Heat Rate (Btu/kWh) = [HR (Btu/kWh) * Annual Op (hr/yr)_{Unfired} + HR (Btu/kWh) * Annual Op (hr/yr)_{Fired}] / [Annual Op (hr/yr)_{Unfired} + Annual Op (hr/yr)_{Fired}]

Proposed Heat Rate = [7,520 Btu/kWh * 3,785 hr/yr + 7,800 Btu/kWh * 4,375 hr/yr] / 8,160 hr/yr = 7,670 Btu/kWh

(7) CO₂ emission factor calculated per 40 CFR Part 75, Appendix G, Equation G-4, as referenced in §98.43(a), where:

CO₂ Emission Factor = 1,040 scf/MMBtu / 385scf/lbmole * 44lb/lbmole = 118.8 lb/MMBtu

Carbon based F-factor, F_C = 1,040 scf/MMBtu

Standard Molar Volume = 385 scf/lbmole

Molecular Weight CO₂, MW_{CO2} = 44 lb/lbmole

(8) CO₂ Emission Rate Net Basis (lb_{CO2}/MWh) = Heat Rate Net Basis (Btu/kWh) * 1MMBtu/1,000,000 Btu * CO₂ Emission Factor (lb_{CO2}/MMBtu) * 1,000 kW/MW

CO₂ Output-Based Emission Rate (Unfired), Net Basis = 7,520 Btu/kWh * 1 MMBtu/1,000,000 Btu * 118.8 lbCO₂/MMBtu * 1,000 kW/MW = 893 lbCO₂/MWh

CO₂ Output-Based Emission Rate (Fired), Net Basis = 7,800 Btu/kWh * 1 MMBtu/1,000,000 Btu * 118.8 lbCO₂/MMBtu * 1,000 kW/MW = 927 lbCO₂/MWh

CO₂ Output-Based Emission Rate (Proposed), Net Basis = 7,670 Btu/kWh * 1 MMBtu/1,000,000 Btu * 118.8 lbCO₂/MMBtu * 1,000 kW/MW = 911 lbCO₂/MWh

LON C HILL REDEVELOPMENT PROJECT
LON C. HILL, LP

GE S207FA.04 with Air Condenser Output-Based CO₂ Emission Rate (Full Load)

Parameter	Units	Unfired	Fired	Proposed
Heat Rate, Net Basis ⁽¹⁾	Btu/kWh (LHV)	6,081	6,305	
Heat Rate, Net Basis ⁽²⁾	Btu/kWh (HHV)	6,741	6,989	
Compliance Margin ⁽³⁾	-	12.3%	12.3%	
Annual Hours of Operation ⁽⁴⁾	hr/yr	3,785	4,375	8,160
Adjusted Heat Rate, Net Basis ^{(5),(6)}	Btu/kWh (HHV)	7,570	7,849	7,719
CO ₂ Emission Factor ⁽⁷⁾	lb _{CO2} /MMBtu	118.8	118.8	118.8
Output-Based CO ₂ Emission Rate, Net Basis ⁽⁸⁾	lb _{CO2} /MWh	899	933	917

Notes

(1) As provided by vendor performance data.

(2) Heat Rate Net Basis (Btu/kWh) (HHV) = Heat Rate Net Basis (Btu/kWh) (LHV) * Ratio HHV/LHV

HHV/LHV Ratio = 1.1 based on fuel heating value (Btu/lbm) per vendor data

(3) Compliance margin (12.3%) accounts for the variance of the design heat rate and the achieved heat rate, losses due to equipment degradation and variability on auxiliary plant equipment.

Design margin = 3.3% reflects possible variation in design vs actual heat rate given actual operating and ambient conditions.

Performance margin = 6.0% reflects efficiency losses due to equipment degradation prior to maintenance overhauls.

Degradation margin = 3.0% reflects the variability in operation of auxiliary plant equipment due to use over time.

(4) Estimated annual hours of operation represent one expected operating scenario and are not intended to limit the permitted operations of Lon C. Hill Power Station. Lon C. Hill Power Station will meet the proposed output-based CO₂ emission rate on a 12-month rolling average and gross basis, regardless of the actual hours of run time in each of the operational modes:

Unfired = 3,785 hr

Fired = 4,375 hr

MSS = 600 hr

(5) Adjusted Heat Rate Net Basis (Btu/kWh) (HHV) = Heat Rate Net Basis (Btu/kWh) (HHV) * (1 + Compliance Margin)

Adjusted Heat Rate Net Basis (Unfired) = 6,741 Btu/kWh (HHV) * (1 + 0.123) = 7,570 Btu/kWh (HHV)

(6) Proposed Heat Rate (Btu/kWh) = [HR (Btu/kWh) * Annual Op (hr/yr)_{Unfired} + HR (Btu/kWh) * Annual Op (hr/yr)_{Fired}] / [Annual Op (hr/yr)_{Unfired} + Annual Op (hr/yr)_{Fired}]

Proposed Heat Rate = [7,570 Btu/kWh * 3,785 hr/yr + 7,849 Btu/kWh * 4,375 hr/yr] / 8,160 hr/yr = 7,719 Btu/kWh

(7) CO₂ emission factor calculated per 40 CFR Part 75, Appendix G, Equation G-4, as referenced in §98.43(a), where:

CO₂ Emission Factor = 1,040 scf/MMBtu / 385scf/lbmole * 44lb/lbmole = 118.8 lb/MMBtu

Carbon based F-factor, F_C = 1,040 scf/MMBtu

Standard Molar Volume = 385 scf/lbmole

Molecular Weight CO₂, MW_{CO2} = 44 lb/lbmole

(8) CO₂ Emission Rate Net Basis (lb_{CO2}/MWh) = Heat Rate Net Basis (Btu/kWh) * 1MMBtu/1,000,000 Btu * CO₂ Emission Factor (lb_{CO2}/MMBtu) * 1,000 kW/MW

CO₂ Output-Based Emission Rate (Unfired), Net Basis = 7,570 Btu/kWh * 1 MMBtu/1,000,000 Btu * 118.8 lbCO₂/MMBtu * 1,000 kW/MW = 899 lbCO₂/MWh

CO₂ Output-Based Emission Rate (Fired), Net Basis = 7,849 Btu/kWh * 1 MMBtu/1,000,000 Btu * 118.8 lbCO₂/MMBtu * 1,000 kW/MW = 933 lbCO₂/MWh

CO₂ Output-Based Emission Rate (Proposed), Net Basis = 7,719 Btu/kWh * 1 MMBtu/1,000,000 Btu * 118.8 lbCO₂/MMBtu * 1,000 kW/MW = 917 lbCO₂/MWh

LON C HILL REDEVELOPMENT PROJECT
LON C. HILL, LP

Proposed MSS BACT Limit

Parameter	Units	Siemens SCC6-5000F	GE S207FA.04 with Cooling Tower	GE S207FA.04 with Air Condenser
Max. Heat Input at Reduced Loads (HHV) ⁽¹⁾	MMBtu/hr (HHV)	1,899	1,864	1,881
CO ₂ Emission Factor ⁽²⁾	lb _{CO2} /MMBtu (HHV)	118.8	118.8	118.8
CO ₂ Emission Rate Limit (SU/SD) ⁽³⁾	ton _{CO2} /hr	113	111	112

Notes:

(1) Average CT heat input per manufacturer data for 75% load or higher

(2) CO₂ emission factor calculated per 40 CFR Part 75, Appendix G, Equation G-4, as referenced in §98.43(a), where:

$$\text{CO}_2 \text{ Emission Factor} = 1,040 \text{ scf/MMBtu} / 385 \text{ scf/lbmole} * 44 \text{ lb/lbmole} = 118.8 \text{ lb/MMBtu}$$

$$\text{Carbon based F-factor, } F_c = 1,040 \text{ scf/MMBtu}$$

$$\text{Standard Molar Volume} = 385 \text{ scf/lbmole}$$

$$\text{Molecular Weight CO}_2, \text{ MW}_{\text{CO}_2} = 44 \text{ lb/lbmole}$$

(3) CO₂ Emission Rate Limit (SU/SD) (ton/hr) = Max. Heat Input (MMBtu/hr) * CO₂ Emission Factor (lb_{CO2}/MMBtu) * 1 ton / 2,000 lb

$$\text{CO}_2 \text{ Emission Rate Limit (Siemens SCC6-5000F)} = 1,899 \text{ MMBtu/hr} * 118.8 \text{ lb/MMBtu} * 1 \text{ ton}/2000 \text{ lb} = 113 \text{ tonCO}_2/\text{hr}$$

$$\text{CO}_2 \text{ Emission Rate Limit (GE S207FA.04 with Cooling Tower)} = 1,864 \text{ MMBtu/hr} * 118.8 \text{ lb/MMBtu} * 1 \text{ ton}/2000 \text{ lb} = 111 \text{ tonCO}_2/\text{hr}$$

$$\text{CO}_2 \text{ Emission Rate Limit (GE S207FA.04 with Air Condenser)} = 1,881 \text{ MMBtu/hr} * 118.8 \text{ lb/MMBtu} * 1 \text{ ton}/2000 \text{ lb} = 112 \text{ tonCO}_2/\text{hr}$$